The Constant Current

The extreme importance of the Galvanic Current in the practice of modern medicine is recognized by the majority of physicians of today, in gynecology, urology, etc., for depilatory work, ionization, rectal lesions, electrolysis, strictures, etc., etc.

There is nothing new that can be said of the constant current which is the fundamental electric force. Whatever therapeutic effects may have been noted by various operators with the direct current, it can in no way change certain physiological and chemical established actions and reactions that alone apply to the direct current.

The effects which concern the physician most are (1) physiological and (2) chemical. It is possible that there are physiological effects due to the nervous stimulus, which can be distinguished ideally, at least, from those due to direct chemical or physical action.

There are four ways in which electrolysis can affect, in the living body, such tissue as muscle by its chemicophysical action:

(1) By the chemical effects of the products liberated at the electrodes or in the substances of the tissues.

(2) By the removal of electrolytes, chiefly inorganic substances which are necessary for the vitality of the tissues, leading to increased absorption of the elements, and perhaps, in consequence, to increased activity of the general nutrition in the tissue, or if the action be more intense, to diminish vitality, degeneration, and death.

(3) By cataphoresis, leading to increase of transferred substances around the negative, and diminution around the positive, and the consequent increase of eliminating or absorbing activity, by which a tissue returns to healthy equilibrium, or to any of the results which follow the disturbance of equilibrium beyond the limits of health.

(4) By raising the local temperature in both cases, but the physiological change may be very different.

EFFECTS OF THE CONSTANT CURRENT

POSITIVE

Physiological-sedative.

Physio-chemical: Accumulation of the negatively-charged ions of oxygen and chlorine.

Formation of an acid caustic, i. e., sulphuric, hydrochloric, nitric, and phosphoric acids.

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Cataphoric: Loss of hydrogen and basic ions; loss of fluid, coagulation.

Starvation of tissues.

Production of a dry, hard, and non-retractile eschar.

Diffusion of ions of oxidizable metal electrodes or ionized solutions.

Antiseptic: First effect of current ischemia; second, hyperemia; but much less marked than at negative pole.

NEGATIVE

(a) Physiological-stimulating.

(b) Physio-chemical: Accumulation of the positively-charged ions of hydrogen, sodium, potassium, calcium and ammonium.

Formation of an alkaline caustic, i. e., the hydrates of sodium, potassium, calcium and ammonium.

Production of a soft, retractile eschar.

Cataphoric: Accumulation of fluid and basic ions.

With mild current nutrition promoted; with high currents denutritive effect.

Anaphoric: Ability to diffuse the positive ions of certain chemical.

Antiseptic moderately. First effect of current, eschemia; second, hyperemia; ultimate effect, equalization of circulatory conditions.

By reason of this physio-chemical polar action, it may be readily seen that the physiological action is both sedative and stimulating; sedative resulting from contact with positive pole because of the cataphoric transfer of the ions of hydrogen and the bases from the region of positive polar contact to and towards that of negative contact, and stimulating at the negative by the increase in that region of fluid and positively-charged ions, which mean at once a hyperemia. By reason of this increased blood supply, stimulating and ultimately nutritional effects follow.

The characteristic action of the positive pole in relation to circulation is one of vasomotor constriction and of the negative one of vasomotor dilation.

The action of the physical effects of the current may be formulated as follows: Electrolysis chemically and cataphoresis mechanically alters the amount and distribution of salts necessary to the proper nutrition and function of the various parts of the living organism. By the latter is a direct transference of the fluids and salts by way of the cell walls, muscle septa, coats of blood vessels, sheaths of nerves, skin, serous and mucous membranes, in fact, all animal membranes which from the physical point of view are all the very best kind of porous diaphragms.

Primarily this action takes place throughout the tissues interposed between the electrodes (not necessarily the nearest way, but along the path of best conduction), but secondarily its influence is felt beyond the interpolar region. Just as it is impossible for a local hemorrhage to exist without its influence being felt beyond the immediate site of the hemorrhage, just so it is impossible to drain a part cataphorically without the influence extending, even to the entire organism.

This physical effect may be carried to the extent of completely cutting off the blood supply, thereby causing immediate and actual destruction (electrolysis of a mole); or by interfering with it to such an extent that there is no channel left by which the inorganic constituents and proteid nutriment can be conveyed to the part with which to feed it, and death from starvation ensues (absorption of an organized inflammatory exudate or an interstitial uterine fibroid); or, in lesser degree, only the normal ionization and osmotic action characteristic of living tissue and necessary to nutrition and normal function. In this latter instance the same physical effect of the current result in a stimulation of normal chemicophysiological processes, i. e., the movement from ion to ion throughout the interpolar circuit, the bodily transfer of complete neutral molecules, and the normal non-electric osmosis.

By this action nutritive changes are initiated and, by a sufficiently frequent repetition of the use of the current, are subsequently fully established. The one condition or the other will obtain according to the quantity of the current and the manner of its use, that is, whether a strong or mild current is used, and whether the application is characterized by current distribution or current density.

The use of a strong current of short duration, characterized by a current density, has either an intense irritant or else a destructive action whereas the same current, if characterized by current distribution, will produce an entirely different effect, because by reason of the increased electrode contact (square inch area), the energy expended in each square inch of surface is diminished in proportion to that increase.

A mild current, if long continued, will cause a profound change in the amount of fluids and salts in a part, and in this physical fact is to be found the therapeutic indication in pathological states, whether characterized by a diminished or altered blood supply, under nutritive activity, pelvic exudates, a benign degenerative process, or by an excess of fluids, as in a sub-acute rheumatism, for example.

Distinction Between Cautery and Electrolysis

Galvanocauterization and electrolysis must not be confounded. In galvanocauterization, use is made of a large quantity of electricity passing through a substance of high resistance, as a platinum loop. The platinum loop, by the transformation of electric energy into heat energy, becomes heated, and it is the heat and not electricity that is utilized in galvanocauterization. The tissues, by the action of galvanocauterization, are destroyed en masse, without any regard to their chemical composition.

In electrolyzing animal tissues, heat is not an element to be considered. There is no more heat than can be accounted for by the activity of the chemical processes going on. The chemical activity in a galvanic cell depends on the strength of the current. In the same manner, the amount and activity of electrolysis in any tissue depends on the current strength sent through the tissues, and the length of time the current is passing.

When electrolysis alone is desired, the electrodes must be composed of some material not acted on by the galvanic current. In this case, the positive pole should be made of some non-oxidizable material, as platinum, carbon, or gold. The negative pole is not acted on by the galvanic current; its composition is therefore a matter of indifference.

H. G. FISCHER & CO.
2323-45 Wabansia Ave. CHICAGO, ILL.